REMARKS

The final Office Action dated January 28, 2008, has been carefully reviewed, and in view of the above changes and following remarks reconsideration and allowance of all the claims pending in the application is respectfully requested.

Claims 1-35 and 51-55 stand rejected. By this Amendment, no claims have been amended. Claims 1-35 and 51-55 remain pending.

The Rejection Under 35 U.S.C. § 102(e) Over Odagawa

Claims 1-3, 7, 10-16, 22-26, 51 and 54 stand finally rejected under 35 U.S.C. § 102(e) as anticipated by Odagawa et al. (Odagawa), U.S. Patent Application Publication No. 2004/0052006 A1.

Applicants respectfully traverse this rejection. Applicants respectfully submit that the subject matter of any of claims 1-3, 7, 10-16, 22-26, 51 and 54 is not anticipated by Odagawa. Further, Applicants respectfully submit that the subject matter of any of claims 1-3, 7, 10-16, 22-26, 51 and 54 is patentable over Odagawa.

Regarding claim 1, Applicants still respectfully submit that Odagawa does not anticipate the subject matter of claim 1. Moreover, Odagawa does not disclose or suggest that the material of interface layer 200 is crystalline when it is in isolation from both the claimed first layer and the claimed tunnel barrier layer. At page 3, lines 3-8, of the final Office Action dated January 28, 2008, the Examiner notes

> "that the phrase "wherein the interface layer material is crystalline wherein it is in isolation from both the first layer and the tunnel barrier layer" is merely the process limitation. The interface layer 220 is formed of Co-Fe alloy, which is the same material being used in the instant application (page 5, lines 35-39 of the instant application) such that the interface layer is inherently crystalline when in isolation from both the first layer and the tunnel barrier layer."

Applicants still respectfully submit that the phrase "wherein the interface layer material is crystalline when it is in isolation from both the first layer and the tunnel barrier layer" appearing

in claim 1 is not a process limitation regardless how the Examiner considers the phrase. Instead, the phrase is a requirement that the interface layer material be crystalline when it is in isolation from both the first layer and the tunnel barrier layer. In other words, the phrase is a requirement that the interface layer material be innately crystalline.

> Further, the Examiner states at page 12, line 19, through page 13, line 4, that "applicant argues Odagawa discloses the interface film 220 is formed from an alloy material including Ni-Co-Fe as a main component and as such, the alloy to which Odagawa refers for interface film 220 is innately amorphous. However, this is merely allegation without any convincing evidences. Nowhere does Odagawa et al. disclose the interface layer 220 formed of Ni-Co-Fe is amorphous. Therefore, Odagawa et al. discloses the interface layer 220 is indeed crystalline when it is in isolation from both the first layer and the tunnel barrier layer."

Applicants respectfully submit that cross-sectional transmission electron microscopy (XTEM) was performed on multilayer films grown by sputtering with the structure 100 Ta/250 $Ir_{22}Mn_{78}$/4 $Co_{49}Fe_{21}B_{30}$/35 $Co_{70}Fe_{30}$/[44 Al_2O_3/t_{CoFe} $Co_{70}Fe_{30}$/100 $Co_{63}Fe_{27}B_{10}$ or $Co_{49}Fe_{21}B_{30}]_{\times 5}$/50 Ta/50 Ru, in which the numbers are the nominal layer thicknesses in Ångström and the Al_2O_3/$Co_{70}Fe_{30}$/CoFeB trilayer in the square brackets was repeated five times on top of one another with a varying $Co_{70}Fe_{30}$ layer thickness t_{CoFe} of 15, 20, 30, 40 and 50 Å. High-resolution micrographs show that, in the as-deposited samples, only $Co_{70}Fe_{30}$ layers equal to or greater than 30 Å are crystalline with a body centered cubic (bcc) structure, but that $Co_{70}Fe_{30}$ layers of smaller thicknesses are innately *amorphous*.

Two examples of multilayers are shown in Fig. 1 below where the CoFeB layer has two different compositions, a first one with a lower concentration of boron, i.e., $Co_{63}Fe_{27}B_{10}$ and a second one with a higher boron concentration, i.e., $Co_{49}Fe_{21}B_{30}$ (Fig. 1 (a,b), respectively). XTEM studies also reveal that the interface layers of $Co_{70}Fe_{30}$ which are innately amorphous, become crystallized when the CoFeB layer on the upper side of this layer becomes crystalline. Because the glass transition temperature of the CoFeB alloy depends on the B content (the lower the B content, the lower the glass transition temperature), only the amorphous CoFe layers in the

structures in Fig. 1 with the smaller B concentration become crystalline when heated to ~260°*C*, a temperature that is higher than the glass transition temperature of $Co_{63}Fe_{27}B_{10}$, but lower than that of $Co_{49}Fe_{21}B_{30}$ (Fig. 1 (d)). Yet $Co_{49}Fe_{21}B_{30}$ remains amorphous up to 300°*C*, and none of the thin innately amorphous (or thicker crystalline) $Co_{70}Fe_{30}$ layers adjacent to $Co_{49}Fe_{21}B_{30}$ show any change in morphology after a similar annealing process (Fig. 1 (c)).

Electron energy loss spectroscopy (EELS) shows that only a negligible amount of boron diffused from the CoFeB layers into the interface $Co_{70}Fe_{30}$ layers after a 300°*C* annealing, implying that the thermal stability of the thin amorphous $Co_{70}Fe_{30}$ layers is not due to incorporation of any diffusive glass-forming boron during the annealing process. Rather, the interface layer of CoFe is innately amorphous because it is sandwiched between two amorphous layers, the amorphous tunnel barrier and the amorphous CoFeB layer; once this proximity requirement is no longer satisfied, e.g., the structure of one of the neighboring layers becomes crystalline, the interface $Co_{70}Fe_{30}$ layer becomes crystallized.

To confirm that the thin $Co_{70}Fe_{30}$ layers are innately amorphous no matter what type of amorphous layers the CoFe layers are sandwiched between, XTEM studies were carried out on all-metallic samples with the structure, 100 Ta/250 $Ir_{20}Mn_{80}$/100 $Co_{49}Fe_{21}B_{30}$/[t_{CoFe}=5, 10, … and 40 $Co_{70}Fe_{30}$/100 $Co_{49}Fe_{21}B_{30}]_{\times 8}$/50 Ta/50 Ru, in which $Co_{70}Fe_{30}$ is sandwiched between two amorphous $Co_{49}Fe_{21}B_{30}$ metallic layers. This sample gives similar XTEM results as shown in Fig. 1 (a), i.e., the CoFe layer is innately amorphous when thin enough and sandwiched between two layers, each themselves amorphous. These studies confirm that the amorphous nature of the thin $Co_{70}Fe_{30}$ layers is innate and comes from being sandwiched between two amorphous layers.

Whilst the XTEM data corresponds to the case of CoFe alloys, it will be plain to those skilled in the art that interface layers formed from other transition metal alloys that have similar properties to those of Co and Fe, e.g., NiFe and NiFeCo and CoNi alloys and other binary and ternary alloys formed from Co, Fe and Ni will also be *innately amorphous*, when sufficiently thin and when sandwiched between an amorphous tunnel barrier and an amorphous metallic layer.

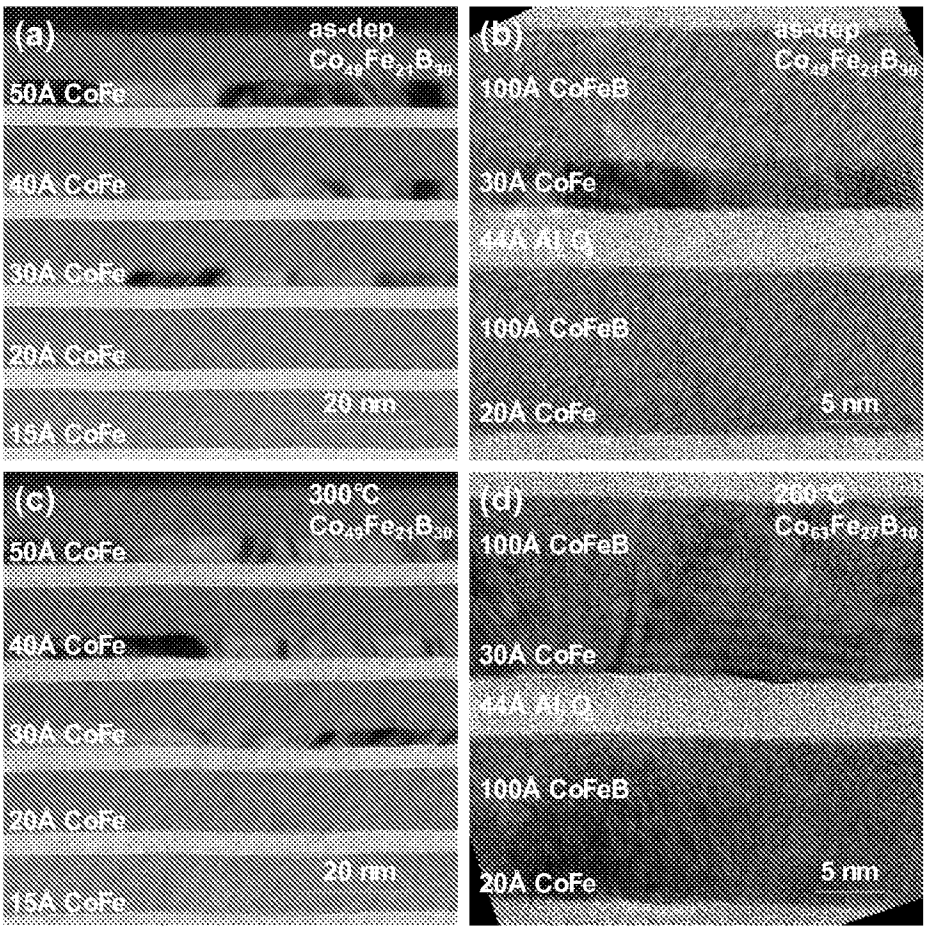

Fig. 1. High-resolution cross-section transmission electron microscopy (XTEM) images corresponding to (a) As-deposited 100 Ta/250 $Ir_{22}Mn_{78}$/4 $Co_{49}Fe_{21}B_{30}$/35 $Co_{70}Fe_{30}$/[44 Al_2O_3/t_{CoFe} $Co_{70}Fe_{30}$/100 $Co_{49}Fe_{21}B_{30}$]$_{\times 5}$/50 Ta/50 Ru with t_{CoFe} of 15, 20, 30, 40 and 50 Å; (b) Higher magnification images of (a) to clearly show 20 Å $Co_{70}Fe_{30}$ is amorphous and 30 Å $Co_{70}Fe_{30}$ is crystalline; (c) Sample with $Co_{49}Fe_{21}B_{30}$ annealed at 300°*C*; (d) Sample with $Co_{63}Fe_{27}B_{10}$ annealed at 260°*C*.

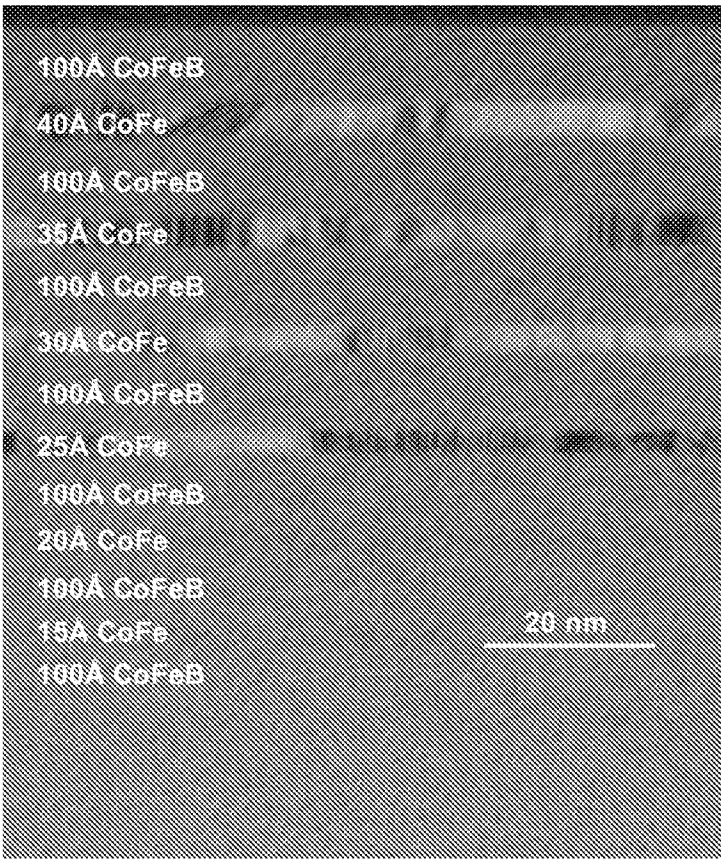

Fig. 2. High-resolution cross-section transmission electron microscopy (XTEM) image for as-deposited all-metallic sample, 100 Ta/250 $Ir_{20}Mn_{80}$/100 $Co_{49}Fe_{21}B_{30}$/[t_{CoFe}=5, 10, … and 40 $Co_{70}Fe_{30}$/100 $Co_{49}Fe_{21}B_{30}]_{\times 8}$/50 Ta/50 Ru. Crystalline CoFe are only observed for nominal thickness 25, 30, 35, and 40 Å.

Accordingly, Applicants still respectfully submit that Odagawa does not disclose or suggest that the material of interface magnetic film 220 is crystalline when it is in isolation from both the first layer and the tunnel barrier layer. Instead, Odagawa discloses that interface magnetic film 220 is formed from "an alloy material containing at least one atom selected from Ni, Co, and Fe as a main component employed."[1] (See Odagawa, paragraph [0194], lines 2-3.)

1 Applicants respectfully note that Odagawa does not state that interface magnetic film 220 is formed from an alloy material containing at least one atom selected from Ni, Co, or Fe as a main component employed. As disclosed by

In this regard, Odagawa discloses that interface magnetic film 220 is formed from an alloy material including Ni-Co-Fe as a main component. (See Odagawa, paragraph [0194], lines 4-8.) As such, Applicants respectfully submit that the alloy to which Odagawa refers for interface magnetic film 220 for the embodiment of Figure 7A is innately amorphous. Accordingly, Applicants respectfully submit that, contrary to the Examiner's assertion that the alloy from which interface magnetic film 220 is formed, interface magnetic film 220 is not formed from the same material as the claimed subject matter. That is, Odagawa discloses that interface magnetic film 220 is formed from an alloy material including Ni-Co-Fe as a main component.

In contrast and in one exemplary embodiment, the claimed interface layer comprises Co-Fe. In further contrast and in another exemplary embodiment, the claimed interface layer comprises Ni-Fe. Applicants still respectfully submit that both exemplary materials are innately crystalline and, accordingly, are crystalline when in isolation from both the first layer and the tunnel barrier layer, as required by claim 1. More generally regarding the claimed subject matter, which is not limited to the exemplary materials just identified as comprising the claimed interface layer, the claimed interface layer is formed from at least one material selected from the group consisting of ferromagnetic materials and ferrimagnetic materials, and such that the claimed interface layer material is crystalline when it is in isolation from both the first layer and the tunnel barrier layer.

Thus, claim 1 is allowable over Odagawa. It follows that claims 2, 3, 7, 10-16, 22-24 and 51, which incorporate the features of claim 1, are each allowable over Odagawa for at least the same reasons that claim 1 is considered allowable.

Regarding claim 25, Applicants respectfully submit that claim 25 is not anticipated by Odagawa for reasons that are similar to the reasons that claim 1 is considered allowable. In particular, Odagawa does not disclose that magnetic interface layer 220 is crystalline when it is in isolation from both the first layer 210 and the tunnel barrier layer 120. Moreover, Odagawa does not suggest that magnetic interface layer 220 is crystalline when it is in isolation from both the first layer 210 and the tunnel barrier layer 120.

Odagawa, interface magnetic film 220 is formed from a Ni-Co-Fe alloy as a main component.

Thus, claim 25 is allowable over Odagawa. It follows that claims 26 and 54, which incorporate the features of claim 25, are each allowable over Odagawa for at least the same reasons that claim 25 is considered allowable.

Consequently, Applicants respectfully request that the Examiner withdraw this rejection and allow claims 1-3, 7, 10-16, 22-26, 51 and 54.

The Rejection Under 35 U.S.C. § 103(a) Over Odagawa

Claims 4-6 stand finally rejected under 35 U.S.C. § 103(a) as unpatentable over Odagawa.

Applicants respectfully traverse this rejection. Applicants respectfully submit that the Examiner's proffered motivation for modifying Odagawa (assuming arguendo that the proffered motivation is proper) does not cure the deficiencies of Odagawa with respect to claim 1, the base claims of each of claims 4-6. In particular, the Examiner's proffered motivation for modifying Odagawa does not result in the Odagawa interface magnetic layer 220 being crystalline when it is in isolation from both the first layer 210 and the tunnel barrier layer 120.

Consequently, Applicants respectfully request the Examiner to withdraw this rejection and allow claims 4-6.

The Rejection Under 35 U.S.C. § 103(a) Over Odagawa In View of Hayakawa

Claims 8, 9, 52 and 53 stand finally rejected under 35 U.S.C. § 103(a) as unpatentable over Odagawa in view of Hayakawa, U.S. Patent Application No. 6,754,100 B1.

Applicants respectfully traverse this rejection. Applicants respectfully submit that Hayakawa does not cure the deficiencies of claim 1, the base claim of each of claims 8, 9, 52 and 53. More specifically, Hayakawa does not disclose or suggest that the Odagawa interface magnetic layer 220 is crystalline when it is in isolation from both the first layer 210 and the tunnel barrier layer 120.

Consequently, Applicants respectfully request that the Examiner withdraw this rejection and allow claims 8, 9, 52 and 53.

The Rejection Under 35 U.S.C. § 103(a) Over Odagawa And Nishimura

Claims 17 and 18 stand finally rejected under 35 U.S.C. § 103(a) as unpatentable over Odagawa and Nishimura, U.S. Patent No. 6,226,197 B1.

This rejection is respectfully traversed. Applicants respectfully submit that Nishimura does not cure the deficiencies of claim 1, the base claim of claims 17 and 18. Specifically, Nishimura does not disclose or suggest that the Odagawa interface magnetic layer 220 is crystalline when it is in isolation from both the first layer 210 and the tunnel barrier layer 120.

Consequently, Applicants respectfully request that the Examiner withdraw this rejection and allow claims 17 and 18.

The Rejection Under 35 U.S.C. § 103(a) Over Odagawa In View Of Saito

Claims 19-21 stand finally rejected under 35 U.S.C. § 103(a) as unpatentable over Odagawa in view of Saito et al. (Saito), U.S. Patent No. 6,556,473 B2.

This rejection is respectfully traversed. Applicants respectfully submit that Saito does not cure the deficiencies of claim 1, the base claim of claims 19-21. In particular, Saito does not disclose or suggest that the Odagawa interface magnetic layer 220 is crystalline when it is in isolation from both the first layer 210 and the tunnel barrier layer 120.

Consequently, Applicants respectfully request that the Examiner withdraw this rejection and allow claims 19-21.

The Rejection Under 35 U.S.C. § 103(a) Over Hosomi In View Of Odagawa

Claims 27-35 and 55 stand finally rejected under 35 U.S.C. § 103(a) as unpatentable over Hosomi et al. (Hosomi), U.S. Patent Application Publication No. 2004/0136232 A1, in view of Odagawa.

Applicants respectfully traverse this rejection. Applicants respectfully submit that the subject matter according to any of claims 27-35 and 55 is patentable over Hosomi in view of

Odagawa. Applicants respectfully submit that the device resulting from the combination of Hosomi in view of Odagawa is not the claimed subject matter.

> "To support the conclusion that the claimed invention is directed to obvious subject matter, either the references must expressly or impliedly suggest the claimed invention or the examiner must present a convincing line of reasoning as to why the artisan would have found the claimed invention to have been obvious in light of the teachings of the references." *Ex parte Clapp*, 227 USPQ 972, 973 (Bd. Pat. App. & Inter. 1985). (See, also, MPEP §§ 706.02(j) and 2144.)

In the present instance, the Examiner does not state that either Hosomi or Odagawa expressly or impliedly suggest the claimed subject matter. Consequently, in order to support the present rejection, the Examiner's line of reasoning must be convincing as to why the artisan would have found the claimed invention to have been obvious in light of the teachings of the references.

Applicants respectfully submit that neither Hosomi nor Odagawa disclose or suggest that the claimed interface layer is formed from at least one material that is crystalline when the material is in isolation from both the first layer and the tunnel barrier layer. The Examiner admits that "Hosomi et al. does [sic] not disclose the magnetic tunnel element having the structure as claimed." (See Office Action dated May 22, 2007, page 10, lines 9-10.) Accordingly, because Hosomi does not disclose the magnetic tunnel element having the structure as claimed, it follows that Hosomi cannot suggest the magnetic tunnel element having the structure as claimed. Consequently, for the combination of Hosomi in view of Odagawa to disclose or suggest all of the limitations of claim 27, all of the limitations of claim 27 must be disclosed or suggested by Odagawa.

As demonstrated above in connection with claim 1, Applicants respectfully submit that Odagawa does not disclose or suggest that the claimed interface layer is formed from at least one material that is crystalline when the material is in isolation from both the first layer and the tunnel barrier layer. That is, Odagawa does not disclose or suggest that the material of interface magnetic film 220 is crystalline when it is in isolation from both the first layer and the tunnel

barrier layer. As previously demonstrated, Odagawa discloses that interface magnetic film 220 is formed from "an alloy material containing at least one atom selected from Ni, Co, and Fe as a main component employed." (See Odagawa, paragraph [0194], lines 2-3.) That is, Odagawa discloses that interface magnetic film 220 is formed from an alloy material including Ni-Co-Fe as a main component. (See Odagawa, paragraph [0194], lines 4-8.) Accordingly, Applicants respectfully submit that the alloy to which Odagawa refers for interface magnetic film 220 for the embodiment of Figure 7A is innately amorphous. Moreover, Applicants respectfully submit that interface magnetic film 220 is not formed from the same material as the claimed subject matter. Odagawa discloses that interface magnetic film 220 is instead formed from an alloy material including Ni-Co-Fe as a main component.

Thus, Applicants respectfully submit that claim 27 is allowable. It follows that claims 28-35 and 55, which incorporate the features of claim 27, are each allowable over Hosomi in view of Odagawa for at least the same reason that claim 27 is considered allowable.

Thus, Applicants respectfully submit that it is only by impermissible hindsight that the Examiner is able to reject claims 27-35 and 55 based on the combination of Hosomi in view of Odagawa. The Examiner does not state that either of Hosomi or Odagawa expressly or impliedly suggests the claimed subject matter. Moreover, the Examiner has not presented a convincing line of reasoning as to why the artisan would have found the claimed invention to have been obvious in light of the teachings of Hosomi and Odagawa. Applicants respectfully submit that it is only by using Applicants' disclosure as a template that the Examiner is able to select particular features of Hosomi and Odagawa through a hindsight reconstruction of Applicants' claims to make the rejection.

Consequently, Applicants respectfully request the Examiner withdraw this rejection and allow claims 27-35 and 55.

Applicants note that additional patentable distinctions between Odagawa, Hayakawa, Nishimura, Saito and Hosomi and the rejected claims exist; however, the foregoing is believed

sufficient to address the Examiner's rejections. Additionally, failure of Applicants to respond to a position taken by the Examiner is not an indication of acceptance or acquiescence of the Examiner's position. Instead, it is believed that the Examiner's positions are rendered moot by the foregoing and, therefore, it is believed not necessary to respond to every position taken by the Examiner with which Applicants do not agree.

CONCLUSION

In view of the above amendments and arguments which present the claims in better form for consideration on appeal, it is urged that the present application is now in condition for allowance. Should the Examiner find that a telephonic or personal interview would expedite passage to issue of the present application, the Examiner is encouraged to contact the undersigned attorney at the telephone number indicated below.

It is requested that this application be passed to issue with claims 1-35, and 51-55.

Respectfully submitted,

Date: April 28, 2008

Joseph P. Curtin
Registration No. 34,571
1469 N.W. Morgan Lane
Portland, Oregon 97229-5291
(503) 296-8373
(503) 297-0452 (facsimile)